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**Measurement of water flow in  
open channels**

**Part 3: Velocity-area methods  
Method 3.3: Measurement by  
slope-area method**

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This Australian Standard was prepared by Committee CE/24, Measurement of Water Flow in Open Channels and Closed Conduits. It was approved on behalf of the Council of Standards Australia on 9 April 1990 and published on 10 December 1990.

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The following interests are represented on Committee CE/24:

Association of Consulting Engineers of Australia  
Australian Water and Wastewater Association  
Board of Works, Melbourne  
Department of Water Resources, NSW  
Engineering and Water Supply Department of South Australia  
Forestry Commission, NSW  
Institute of Instrumentation and Control  
Monash University  
Public Works Department, NSW  
Snowy Mountains Engineering Corporation  
University of New South Wales  
University of Queensland  
Water Authority of Western Australia  
Water Board, Sydney  
Water Resources Commission, Queensland

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## PREFACE

This Standard was prepared by the Standards Australia Committee on Measurement of Water Flow in Open Channels and Closed Conduits. It is identical with and has been reproduced from ISO 1070 — 1973, *Liquid flow measurement In open channels — Slope-area method*.

This Standard is one of a series which deals with methods of measurement of water flow in open channels. The series when complete will consist of the following parts:

- Part 1: Vocabulary and symbols
- Part 2.1: General—Guidelines for the selection of methods of measurement
- Part 2.2: General—Establishment and operation of a gauging station
- Part 2.3: General—Determination of the stage-discharge relation
- Part 2.4: General—Estimation of uncertainty of a flow-rate measurement
- Part 2.5: General—Guidelines for the selection of flow gauging structures
  
- Part 3: Velocity-area methods
  - Method 3.1: Measurement by current-meters and floats
  - Method 3.2: Measurement by moving-boat method
  - Method 3.3: Measurement by slope-area method (This Standard)
  - Method 3.4: Collection and processing of data for determination of errors in measurement
  - Method 3.5: Investigation of total error
  - Method 3.6: Measurement of flow in tidal channels
  - Method 3.7: Measurement by ultrasonic (acoustic) method
  - Method 3.8: Electromagnetic method using a full-channel-width coil
  
- Part 4: Measurement structure methods
  - Method 4.1: Thin-plate weirs
  - Method 4.2: Rectangular broad-crested weirs
  - Method 4.3: Round-nose horizontal broad-crested weirs
  - Method 4.4: V-shaped broad-crested weirs
  - Method 4.5: Triangular profile weirs
  - Method 4.6: Flat-V weirs
  - Method 4.7: Rectangular, trapezoidal and U-shaped flumes
  - Method 4.8: Trapezoidal profile weirs
  - Method 4.9: Parshall and Saniiri flumes
  - Method 4.10: End-depth method for estimation of flow in rectangular channels with a free overfall
  - Method 4.11: End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method)
  
- Part 5: Dilution methods
  - Method 5.1: Constant-rate injection method for the measurement of steady flow
  - Method 5.2: Integration method for the measurement of steady flow
  
- Part 6.1: Measuring devices, instruments and equipment —Rotating element current-meters
- Part 6.2: Measuring devices, instruments and equipment —Direct depth sounding
- Part 6.3: Measuring devices, instruments and equipment —Calibration of rotating element current-meters in straight open tanks
- Part 6.4: Measuring devices, instruments and equipment —Echo sounders for water depth measurements
- Part 6.5: Measuring devices, instruments and equipment —Water level measuring devices
- Part 6.6: Measuring devices, instruments and equipment —Cableway system for stream gauging
- Part 6.7: Measuring devices, instruments and equipment —Ultrasonic (acoustic) velocity meters
- Part 6.8: Measuring devices, instruments and equipment —Position fixing equipment for hydrometric boats

For the purpose of this Australian Standard, the ISO text should be modified as follows:

- (a) Wherever the words 'International Standard' appear, referring to this Standard, they should be read as 'Australian Standard'.
- (b) Wherever the word 'fluid' appears, it should be read as 'water'.
- (c) Substitute a point (.) for a comma (,) as a decimal marker.
- (d) The references to other publications should be replaced by references to Australian Standards as follows.

<i>Reference to International Standard</i>	<i>Australian Standard</i>
ISO	AS
772	3778
Liquid flow measurement in open channels—Vocabulary and symbols	Measurement of water flow in open channels
1100/1	3778.1
Liquid flow measurement in open channels—Part 1: Establishment and operation of a gauging station	Part 1: Vocabulary and symbols
1100/2	3778.2.2
Liquid flow measurement in open channels—Part 2: Determination of the stage—discharge relation	Part 2.2: General— Establishment and operation of a gauging station
748	3778.2.3
Liquid flow measurement in open channels—Velocity-area methods	Part 2.3: General—Determination of the stage-discharge relation
	3778.3
	3778.3.1
	Part 3: Velocity-area methods
	Method 3.1: Measurement by current-meters and floats

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# Measurement of water flow in open channels

## Part 3: Velocity-area methods

### Method 3.3: Measurement by slope-area method

#### 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the method of determining the slope and area of cross-section of the stream, and of computing the discharge therefrom. The method provides an approximate estimate of the discharge in somewhat special conditions in the stream and is used when estimation of discharge by more accurate methods, like the velocity-area methods, is not possible. The slope-area method can be used with some degree of accuracy in channels with stable boundaries such as rock (or very cohesive clay) bed and sides, and in channels with relatively coarse bed material; this method may also be used in other cases such as alluvial channels including channels with defined spills or non-uniform channel sections, subject to the acceptance of larger errors involved in the selection of the value of the Manning's coefficient  $n$  or Chezy's coefficient  $C$ . It is, however, not desirable to use this method in the case of very large channels or channels with very flat slopes of high sediment concentration or channels with significant curvature.

This International Standard deals only with ad hoc measurements of discharge and should not be employed for establishing rating-curves. Although the accuracy of results from applying the slope-area method is less than that from applying the velocity-area methods, it is sometimes necessary to use the slope-area method to define the extreme high-stage end of rating-curves because the magnitude of extremely rare floods is such that other methods of measuring discharge cannot be used.

#### 2 REFERENCES

ISO 748, *Liquid flow measurement in open channels by velocity-area methods*.

ISO 772, *Liquid flow measurement in open channels — Vocabulary and symbols*.

ISO 1100, *Liquid flow measurement in open channels — Establishment and operation of a gauging-station and determination of the stage-discharge relation*.

#### 3 DEFINITIONS

For the purpose of this International Standard, the definitions given in ISO 772 apply.

#### 4 UNITS OF MEASUREMENT

The units of measurement used in this International Standard are seconds and metres (or feet).

#### 5 PRINCIPLE OF THE METHOD OF MEASUREMENT

A measuring-reach is chosen for which the mean area of cross-section of the stream is determined and the surface slope of the flowing water in that reach is measured. The mean velocity is then established by using known empirical formulae which relate the velocity to the hydraulic mean depth, the surface slope corrected for kinetic energy of the flowing water and the characteristics of the bed and bed material. The discharge is computed as the product of the mean velocity and the mean area of cross-section of the stream.

#### 6 SELECTION AND DEMARCATION OF SITE

##### 6.1 Initial survey of site

It is desirable that approximate measurements of widths, depths and surface slopes should be made in a preliminary survey to decide on the suitability of a site conforming, as far as possible, with the conditions given in 6.2 and 6.3. It is intended that these measurements should only serve as a guide.

##### 6.2 Selection of site

**6.2.1** The accuracy of the determination of discharge by the slope-area method is increased if the river-banks and bed are reasonably stable and the river-reach fairly straight and uniform in section and free from obstructions and disturbances.

**6.2.2** The length of the reach depends upon river slopes at very low stages and flood stages. The slope shall be such that the surface fall in the length of the reach used at each site is at least ten times the expected error in "measurement of fall".

**6.2.3** The flow in the reach shall be free from significant disturbances due to the effect of tributaries joining upstream or downstream or of any structure. The reach shall be one in which no substantial expansion occurs.